# The Mars Electrostatics Chamber

To fill the need for the increased research activity around NASA's exploration of Mars, the Electromagnetic Physics Testbed at Kennedy Space Center activated the Center's first operational Mars environmental simulation process, the Mars Electrostatics Chamber. Several important environmental characteristics of Mars have been replicated in this chamber, including temperature, pressure, and atmospheric composition. Integration of existing and newly acquired hardware with a centralized controller was performed to bring about successful near-autonomous operation.

The Mars Electrostatics Chamber is 2 meters in length, 1.3 meters in diameter, and has a volume of 1.5 $m^3$ (Fig. 1). The chamber has a 1.43 m x 0.80 m Experiment Deck, has a vacuum depressurization time of 20 min, controlled repressurization time of 10 minutes, and can be repressurized in an emergency in 10 min. Access ports are provided for component and peripheral device feed-though. In addition, ports are used for existing pressure measurement, temperature signal lines, and gas feed-throughs. Access ports are also provided for monitoring payloads. The inside of the chamber has been fitted with a cooling shroud.

The Mars Electrostatics Chamber has been outfitted with an automated control system with a graphical user interface. The automation system consists of three major systems: pressure control, atmospheric control, and temperature control. The atmosphere control system is utilized to monitor and maintain the gasses contained within the chamber. The pressure control system is used to lower the pressure of the chamber to that of the Martian atmosphere. The temperature control system replicates temperatures within actual minimum and maximum values as would be experienced on Mars. A liquid/gaseous nitrogen supply was used to obtain this temperature range, as well as various heating techniques. Fundamental to the stabilization of temperature within the chamber was the optimal control of extremely cold nitrogen. After incessant testing and characterization, significant cooling implementation design changes, and controller instrumentation modifications, this cryogenic supply was successfully manipulated by a programmable controller system with appropriate programming. A cooling test is shown in figure 2.

A manual control panel has been developed to add more flexibility to the chamber and as an alternative to the graphical user interface. This panel allows experimenters to select individual settings and perform manual tests while still maintaining the safety associated with an automated system. The chamber operating characteristics are shown in Table 1.

Experiments using Mars Electrostatics Chamber are currently under way.

Contact: Dr. Carlos Calle, YA-F2-T, (321) 867-3274, Carlos.Calle-1@ksc.nasa.gov

Participating Organizations: VirCon Engineering (R.K. Buchanan, A.C. Barnett), YA-F1-T (D.C. Lewis)

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**Figure 1**

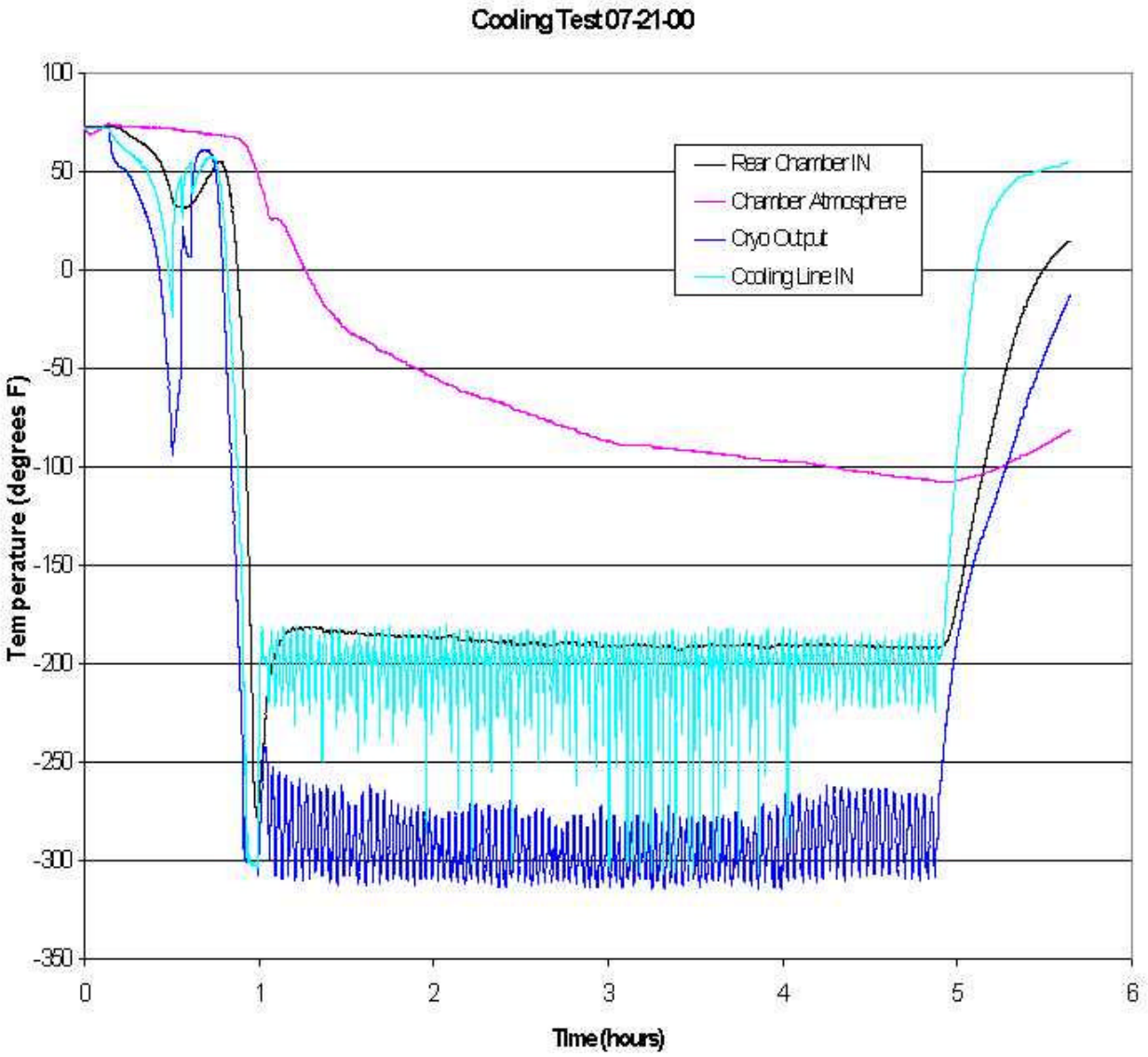


**Figure 2**

**Table 1. Mars Electrostatics Chamber Operating Characteristics**

| Operating Characteristics | Minimum | Typical | Maximum |
|---|---|---|---|
| Operating Pressure | 0.2 Torr | 7 Torr | 760 Torr |
| Operating Temperature | -120 ?C | -100 ?C | 200 ?C |
| Pneumatic Line Pressure | | 760 kPa | 860 kPa |
| Chamber Pressure | | | 130 kPa |
| Cooling Line Pressure | | | 1000 kPa |
| Baketout Temperature | | 150 ?C | 200 ?C |
| Bakeout Pressure | | 0.5 Torr | |